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FLAMMABILITY OF A POLYETHYLENE IDLER ROLL

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FLAMMABILITY OF A POLYETHYLENE IDLER ROLL

by

K.J. Mintz*

ABSTRACT

Upon request from International Minerals and Chemical Corporation, the flammability of a polyethylene idler roll proposed for use in an underground potash mine has been determined. Because there are no criteria for deciding on the degree of flammability required, the approach adopted was to compare it to the fire-retardant beltings currently used. In all four tests carried out (flame, critical oxygen index, hot plate ignition, and minimum ignition temperature), the idler roll yielded significantly poorer results than even non fire-resistant conveyor belting. It is concluded, therefore, that use of this idler roll would increase the flammability hazard of the conveyor system.

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INFLAMMABILITÉ D'UN CYLINDRE À VIDE EN POLYÉTHYLÈNE

par

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RÉSUMÉ

À la demande de International Minerals and Chemical Corporation, on a mené des essais visant à déterminer le degré d'inflammabilité d'un cylindre à vide devant être utilisé dans une mine de potasse souterraine. En raison de l'absence de critères concernant le degré d'inflammabilité permis, on a décidé d'établir une comparaison entre le cylindre et les courroies de transmission ignifugées en usage actuellement. Les résultats de quatres essais (essai à la flamme, indice critique d'oxygène, allumage de la plaque chauffante et température minimale d'allumage, indiquent que la performance du cylindre à vide a même été de beaucoup inférieure à celle de la bande transporteuse non ignifugée d'un convoyeur. Par conséquent, l'utilisation d'un tel cylindre à vide augmenterait les risques d'inflammabilité du circuit transporteur.

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INTRODUCTION

International Minerals and Chemical Corporation (IMC), Esterhazy, Sask., are considering replacing conventional metal idler rolls ones with polyethylene in the mine conveyor belt system that transports potash ore from the mine face. Before installation, IMC wanted to know whether these were safe from the flammability point of view. Hence, they requested CEAL to carry out appropriate fire-resistance tests.

There are no standard tests for this type of evaluation. Since the idler roll would be used in a conveyor system which uses fire-retardant conveyor belting, the approach taken here was to compare the flammability of the idler roll to the conveyor belting and show that it is either less or more flammable. This is not necessarily a straightforward proposition: different tests evaluate different aspects of flammability and therefore the relative 'fire-resistance' may depend on the particular test. Hence, several tests were carried out in this study so as to be able to reach a definitive conclusion.

RESULTS AND DISCUSSION

THE EMR SMALL-SCALE FLAME TEST

This test is a modification of the U.S.A. Mine Safety and Health Administration test (1) used for determining the acceptability of conveyor belting used in underground mines. A 12.5 x 150 mm sample is exposed to a bunsen burner flame for one minute and the time for flame and glow to disappear is measured. It is primarily a test of self-extinguishability. The flames must disappear in one minute and the glow in 3 min. In the MSHA test, flowing air is applied after the burner is withdrawn; in the EMR version (2,3), both flowing air and still air tests are carried out.

During the application of the bunsen burner flame to the sample of the idler roll, considerable melting and dripping occurred. In both the still air and flowing air tests, after the burner was removed, the flames did not go out by themselves and had to be extinguished. The flames spread more rapidly in the flowing air test (which is supposed to simulate the ventilation in the mine), than in the still air test. The results on this test were one of the worst ever recorded in this laboratory.

Critical Oxygen Index (COI) Test

In this test, the minimum percentage of oxygen, in a flowing oxygen/nitrogen stream, that can maintain flaming combustion is measured (4). The details of the method used at CEAL are given in (5). The COI value obtained was 17.8%. For comparison, a published value for polypropylene, which should yield a similar COI value (based on the chemical formula) is 18.1% (6). Since the COI depends on the quantity of fire-retardant chemicals added for a given type of material (7), it seems most likely that the polyethylene idler roll contains no added fire-retardants.

Fire-retardant conveyor belting that meet EMR specifications have always yielded COI's above 27%. Even non fire-retardant belting generally have COI's in the range 21-25%. Although the use of the COI at CEAL is proposed for quality assurance only and not as a direct measure of flammability, the fact that the value of the COI is well below the % O_2 in normal air can be considered as an indication that the idler roll could burn in partially sealed drifts where conveyor belting, for example, might self-extinguish for lack of oxygen.

Hot-Plate Ignition (HPI) Test

The HPI test measures the propensity of a material to ignite on a hot surface (8). A 25 mm square sample is placed on a type 310 stainless steel plate that had been heated to a set temperature and the time to flaming ignition is measured. The results are shown in Fig. 1. The meaning of the lowest temperature point is that the sample combusted completely but did not burst into flames. A comparison with conveyor belting is shown in Fig. 2. As can be seen, the idler is more flammable under the conditions of this test than even non fire-retardant conveyor belting.

Minimum Ignition Temperature (MIT) Test

The American Society for Testing and Materials have a Standard, D1929-77, for the MIT of plastics. A small sample of the test material is suspended in a tube which has heated air at a constant temperature flowing through it. The conditions of the test are varied until the minimum temperature at which a sample ignites spontaneously is determined. Although, at present, CEAL does not have the exact apparatus specified in that Standard, a similar apparatus was set up for the purpose of this investigation.

The MIT for self-ignition of the idler was determined to be 380 ± 10°C. Below that temperature, the sample combusted without flames or flow. For comparison, a non-fire-retardant conveyor belting made of natural rubber covers and a fabric carcass was tested in the same apparatus and yielded an MIT of 480 ± 10°C.

CONCLUSIONS

In all four flammability tests carried out in this study, the polyethylene idler performed significantly worse than non fire-retardant conveyor belting. Hence, there appears to be little doubt that use of this product would increase the flammability hazard of the conveyor system. The polyethylene obviously does not contain any fire-retardant chemicals. It should be possible to manufacture an idler roll with a fire-retardant polyethylene formulation. If a product is made that would have similar flammability characteristics as the type of conveyor belting used in the mine, then the conclusion could be drawn that the idler would not present any additional flammability hazards from an external fire. However, it may be necessary to consider the hazards from the actual operation, e.g., if excessive frictional heat is created when the belt is rubbing against the polyethylene idler roll.

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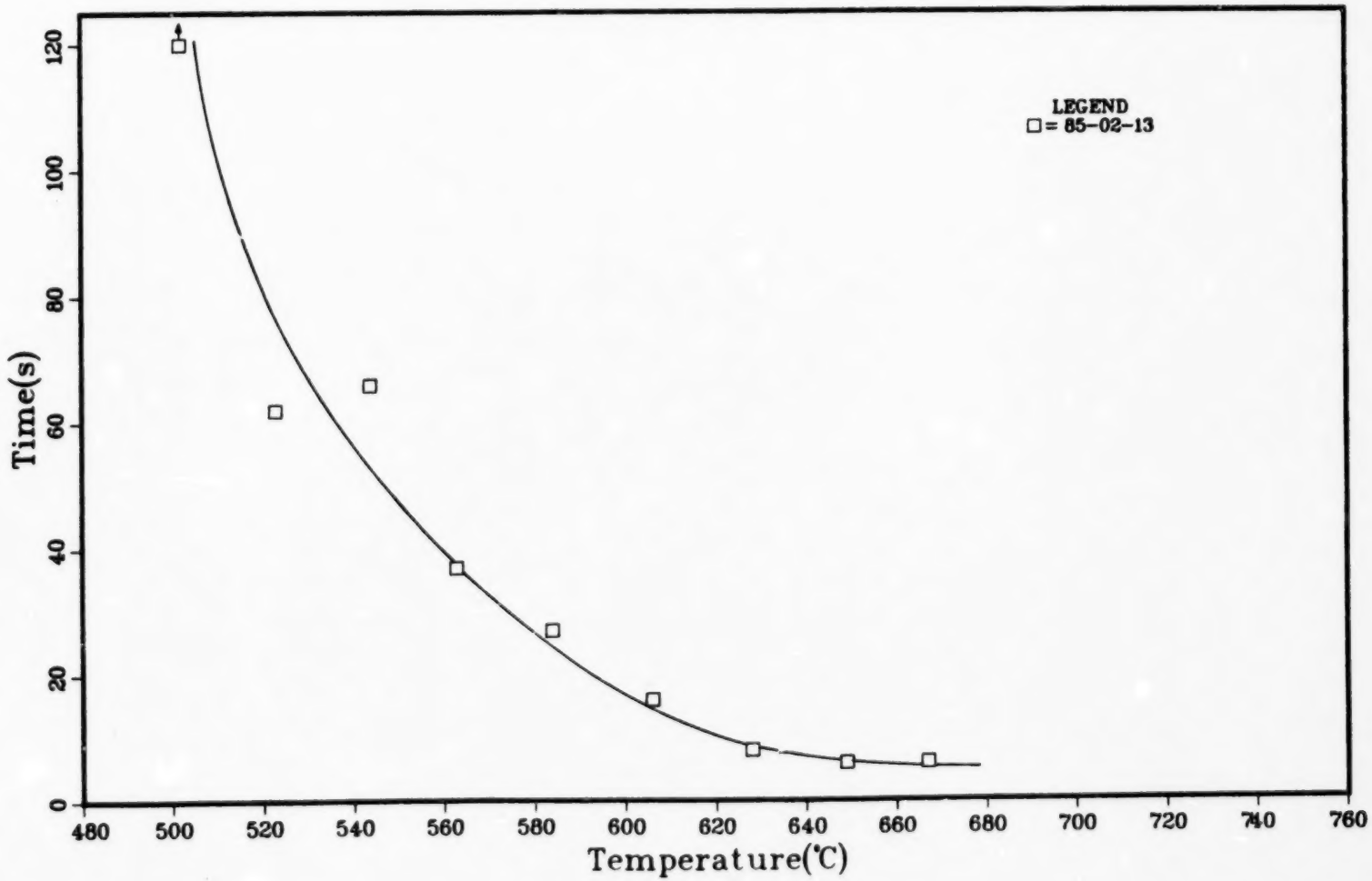

Fig. 1 - Hot-plate tests on the idler roll

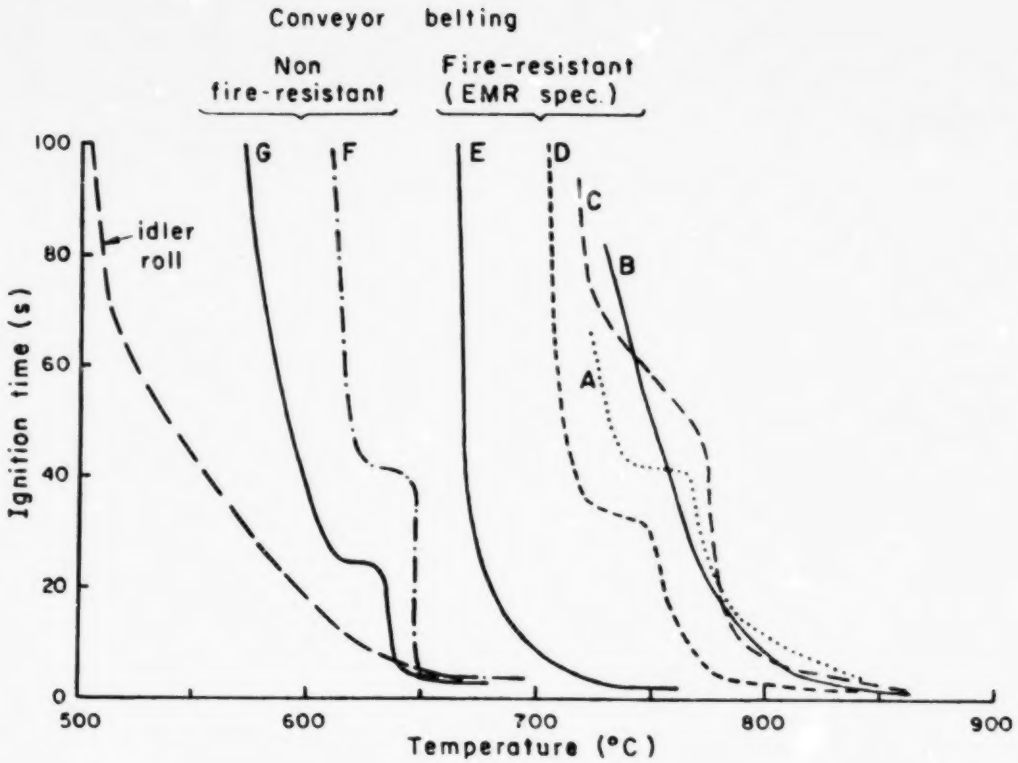

Fig. 2 - Comparison of HPI tests on idler roll with conveyor beltings